# PATENT ABSTRACTS OF JAPAN

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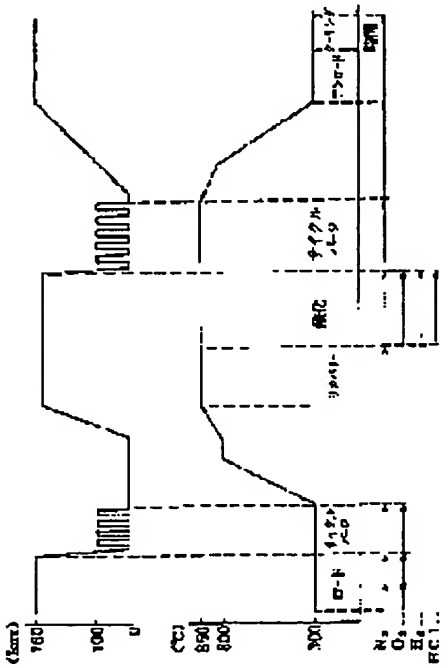
## (54) METHOD AND DEVICE FOR OXIDATION

(57)Abstract:

PROBLEM TO BE SOLVED: To suppress the formation of a natural oxidized film by housing an object to be treated in a treating furnace preheated to a prescribed temperature and oxidizing the object, by supplying a process gas after the temperature in the furnace is raised to a treating temperature under a reduced pressure.

SOLUTION: After the inside of a treating furnace is opened to the atmosphere and heated to a prescribed temperature with a heater, a wafer boat carrying many semiconductor wafers is loaded into the treating furnace. Then the inlet of the furnace is closed with a lid body and the pressure in the furnace is reduced by evacuating the air in the furnace by means of an evacuating system. At the time of loading the wafers into the furnace and performing cycle purging, an inert gas is supplied to the furnace so that no natural oxide film may be formed on the surfaces of the wafers. Then the inside of the furnace is raised to a prescribed treating temperature by controlling the heater in the evacuated state and the evacuating system is switched to a plant exhaust system by means of a change-over valve. Under such a condition, the temperatures of the wafers are stabilized by performing recovery and desired oxidation is performed. After oxidation, the wafer boat is unloaded from the furnace and the wafers are cooled to a transportable temperature.



LEGAL STATUS

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CLAIMS

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[Claim(s)]
[Claim 1] The oxidation-treatment approach which holds a processed object in the processing furnace beforehand heated by predetermined temperature, is made to carry out temperature up of the inside of a processing furnace to predetermined processing temperature, and is characterized by performing the process of said temperature up under reduced pressure in the approach of supplying raw gas and oxidizing a processed object.
[Claim 2] The oxidation-treatment approach according to claim 1 characterized by decompressing the inside of a processing furnace after the process of said oxidation treatment.
[Claim 3] The oxidation-treatment approach according to claim 1 or 2 characterized by including the cycle purge which repeats supply and a halt of inert gas by turns while said reduced pressure carries out vacuum suction of the inside of a processing furnace.
[Claim 4] The oxidation-treatment approach characterized by carrying out vacuum suction of the inside of a processing furnace before and after the process of said oxidation treatment in the approach of holding a processed object in a processing furnace, supplying raw gas, and oxidizing at predetermined processing temperature.
[Claim 5] The oxidation-treatment approach according to claim 4 characterized by supplying nitrogen-monoxide gas or dinitrogen-oxide gas after the process of said oxidation treatment, and in a processing furnace, and performing diffusion process.
[Claim 6] The oxidation-treatment approach according to claim 4 characterized by including the cycle purge whose process of said vacuum suction repeats supply and a halt of inert gas by turns while carrying out vacuum suction of the inside of a processing furnace.
[Claim 7] In the equipment which holds a processed object in a processing furnace, supplies raw gas, and is oxidized at predetermined processing temperature A raw gas supply means to supply raw gas in said processing furnace, and the works exhaust air system which exhausts the inside of said processing furnace by predetermined exhaust gas pressure, Oxidation-treatment equipment characterized by having the means for switching which switches the evacuation system which carries out vacuum suction of the inside of said processing furnace by the pressure lower than the exhaust gas pressure of said works exhaust air system, and said works exhaust air system and evacuation system.
[Claim 8] Oxidation-treatment equipment according to claim 7 characterized by forming the possible combination bulb of closing motion and pressure accommodation, and the vacuum pump in said evacuation system.
[Claim 9] The oxidation-treatment equipment characterized by to have held a processed object in a processing furnace, to have been prepared in the equipment which supplies raw gas and oxidizes at predetermined processing temperature in a raw gas supply means supply raw gas in said processing furnace, the evacuation system which has a vacuum pump for evacuating the inside of said processing furnace, and this evacuation system, and to have the combination bulb in which pressure regulation is possible before predetermined vaccum pressure from closing motion and an atmospheric pressure.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the oxidation-treatment approach and oxidation-treatment equipment.
[0002]
[Description of the Prior Art] For example, in the manufacture process of a semiconductor device, there is an oxidation-treatment process which forms an oxide film in the front face of the semi-conductor wafer which is a processed object, and there is the approach of oxidizing as the one approach of this oxidation treatment by contacting a semi-conductor wafer with a steam at predetermined processing temperature in a processing furnace (wet oxidation). And the burner which hydrogen gas and oxygen gas are made to react (combustion), and is made to generate a steam is independently formed in the exterior of a processing furnace, and the oxidation-treatment equipment which supplies the steam generated with this burner to a processing furnace, and was made to perform oxidation treatment is known as it is shown in JP,63-210501,A etc. in order to perform such oxidation treatment for example.
[0003] Since it was processing in conventional oxidation-treatment equipment by controlling the inside of a processing furnace by the works exhaust air system to about -5mmH2O--10mmH2O to fine reduced pressure (760Torr), for example, atmospheric pressure, Many parts which are not leak tightness (airtight) exist in the seal section of the whole system. This sake, Also when inert gas permuted the inside of a processing furnace (purge), the technique of vacuum suction could not be adopted but the technique of extruding the residual gas in a processing furnace by supply of inert gas was adopted.
[0004]
[Problem(s) to be Solved by the Invention] However, it sets to conventional oxidation-treatment equipment thru/or the conventional oxidation-treatment approach. In the inert gas purge of said technique, an oxidation kind from the ability not to fully eliminate For example, a semi-conductor wafer is held in the processing furnace beforehand heated by predetermined temperature, temperature up of the inside of a processing furnace was carried out to predetermined processing temperature, and when raw gas was supplied and a semi-conductor wafer was oxidized, there was a problem that the natural oxidation film was easy to be formed, at the process of the temperature up. Moreover, although pole thinning of an oxide film was demanded with detailed-izing of a semiconductor device, by conventional oxidation-treatment equipment thru/or the conventional oxidation-treatment approach, membraneous quality and thickness were uniform, the limitation was to form the ultra-thin oxide film which was excellent in quality, and about 5nm was a limitation as thickness of an oxide film.
[0005] This invention was made in consideration of the above-mentioned situation, can fully control formation of the natural oxidation film in a temperature-up process, and aims at offering the oxidation-treatment approach and oxidation-treatment equipment which can form the ultra-thin oxide film which was excellent in quality.
[0006]
[Means for Solving the Problem] Invention which relates to claim 1 among this inventions holds a processed object in the processing furnace beforehand heated by predetermined temperature, carries

out temperature up of the inside of a processing furnace to predetermined processing temperature, and is characterized by performing the process of said temperature up under reduced pressure in the approach of supplying raw gas and oxidizing a processed object.
[0007] Invention concerning claim 2 is characterized by decompressing the inside of a processing furnace after the process of said oxidation treatment in the oxidation-treatment approach according to claim 1.
[0008] In the oxidation-treatment approach according to claim 1 or 2, invention concerning claim 3 is characterized by including the cycle purge which repeats supply and a halt of inert gas by turns, while said reduced pressure carries out vacuum suction of the inside of a processing furnace.
[0009] Invention concerning claim 4 is characterized by carrying out vacuum suction of the inside of a processing furnace before and after the process of said oxidation treatment in the approach of holding a processed object in a processing furnace, supplying raw gas, and oxidizing at predetermined processing temperature.
[0010] Invention concerning claim 5 is characterized by supplying nitrogen-monoxide gas or dinitrogen-oxide gas after the process of said oxidation treatment, and in a processing furnace, and performing diffusion process in the oxidation-treatment approach according to claim 4.
[0011] In the oxidation-treatment approach according to claim 4, invention concerning claim 6 is characterized by including the cycle purge to which supply and a halt of inert gas are repeated by turns, while the process of said vacuum suction carries out vacuum suction of the inside of a processing furnace.
[0012] In the equipment which invention concerning claim 7 holds a processed object in a processing furnace, supplies raw gas, and is oxidized at predetermined processing temperature A raw gas supply means to supply raw gas in said processing furnace, and the works exhaust air system which exhausts the inside of said processing furnace by predetermined exhaust gas pressure, It is characterized by having the means for switching which switches the evacuation system which carries out vacuum suction of the inside of said processing furnace by the pressure lower than the exhaust gas pressure of said works exhaust air system, and said works exhaust air system and evacuation system.
[0013] Invention concerning claim 8 is characterized by forming the possible combination bulb of closing motion and pressure accommodation, and the vacuum pump in said evacuation system in the oxidation-treatment approach according to claim 7.
[0014] Invention concerning claim 9 holds a processed object in a processing furnace, is prepared in the equipment which supplies raw gas and oxidizes at predetermined processing temperature in a raw gas supply means supply raw gas in said processing furnace, the evacuation system which have a vacuum pump for evacuating the inside of said processing furnace, and this evacuation system, and is characterized by to have the combination bulb in which pressure regulation is possible before predetermined vaccum pressure from closing motion and an atmospheric pressure.
[0015]
[Embodiment of the Invention] Below, the gestalt of operation of this invention is explained in full detail based on an accompanying drawing. it be the processing furnace of a batch type in the vertical mold which 1 hold the semi-conductor wafer W which be a processed object, and supply a steam as raw gas, for example, be oxidize under an about 850 - degree C elevated temperature, and this processing furnace 1 consist of a coil 2 made from a quartz which have the thermal resistance of the shape of a longwise cylinder which the upper bed be blockaded and the soffit opened, for example in drawing 1 which show the whole oxidation treatment equipment configuration which be the gestalt of the 1st operation of this invention.
[0016] This coil 2 constitutes the airtight high processing furnace 1 by blockading airtightly soffit opening opened as a throat with a lid 3. said lid 3 top -- many -- for example, the wafer boat 4 made from a quartz which is the substrate support which sets spacing in the vertical direction in the level condition, and supports about several semi-conductor wafers, for example, 150 sheets, W to multistage is laid through the heat insulating mould 5.
[0017] The lid 3 is constituted by the elevator style which is not illustrated so that closing motion of loading (carrying in) of the wafer boat 4 into the processing furnace 1, an unload (taking out), and a throat may be performed. moreover -- the perimeter of said coil 2 -- the inside of a furnace --

predetermined temperature, for example, 300-1000 degrees C, -- heating -- the controllable heater 6 is formed. The gas installation tube part 7 is suitably formed in the bottom section of a coil 2 the number of pieces, and the burner 8 which is made to generate a steam by the combustion reaction of hydrogen gas H2 and oxygen gas O2, and is supplied as a raw gas supply means (steam supply means) is connected to one of them.

[0018] As for this burner 8, it is desirable that it is constituted possible that what was 6l./m (minimum) the very small flow rate, for example, conventionally, about the steam by making aperture of for example, a combustion nozzle small, or improving the configuration of a combustion nozzle etc. supplies by about per minute 0.6-0.3l. Moreover, in order that dilution etc. may carry out a steam, the inert gas feed zone 9 which supplies inert gas N2, for example, nitrogen gas, is formed in the burner 8. In addition, the source of gas supply which supplies, raw gas NO, for example, nitrogen-monoxide gas, other dinitrogen-oxide gas N2O, or other inert gas, for example, N2 grade, is connected to other gas installation tube parts (graphic display abbreviation).

[0019] Moreover, the exhaust pipe section 10 for exhausting the inside of a coil 2 is formed, and in order to drain the drain water which the steam under exhaust air condensed and produced, the 1st duct 11 is connected to the bottom wall of said coil 2 through the exhaust pipe 12 made from a quartz at this exhaust pipe section 10. The ball valve 13 may be formed between an exhaust pipe 12 and the 1st duct 11. While the 2nd duct 15 is connected through the piping 14 for condensation of the water cooling type which started from this, the hand valve 16 for draining drain water collected on the 1st duct 11 is connected to the 1st duct 11. It is desirable that the valve 17 and trap 18 of a pneumatic-control type are prepared between the 1st duct 11 and a hand valve 16.

[0020] The replaceable evacuation system 20 is connected to the 2nd duct 15 through the change-over valves 21 and 22 of the pneumatic-control type which is a means for switching with inert gas, N2 [ for example, ], carrying out vacuum suction of the inside of the processing furnace 1 before and after said oxidation-treatment process with the works exhaust air system 19 which exhausts the inside of the processing furnace 1 at the process of said oxidation treatment. The exhaust-gas-pressure control valve 23 for controlling exhaust gas pressure to about -5mmH2O--10mmH2O to predetermined pressure (760Torr), for example, atmospheric pressure, is formed in the works exhaust air system 19. The ball valve 24 may be formed in the lower stream of a river of this exhaust-gas-pressure control valve 23. As for the 1st and 2nd ducts 11 and 15, it is desirable that it is, the ingredient, for example, the product, made from Teflon (trade name) which has corrosion resistance. Moreover, into the 2nd duct 15, when it changes into the application-of-pressure condition more than ordinary pressure (atmospheric pressure) or ordinary pressure, it is desirable that the pressure switch 25 for detecting this and emitting an alarm is formed.

[0021] The possible combination bulb 26 of closing motion and pressure accommodation and the inside of the processing furnace 1 are established in the vacuum pump 27 which can be decompressed to a maximum of ten to 3 Torr extent by said evacuation system 20. As a vacuum pump 27, a dry pump is desirable, for example. The change-over valve 22 and the combination bulb 26 of the 2nd duct 15 are connected for the 1st piping 28, and the combination bulb 26 and the vacuum pump 27 are connected for the 2nd piping 29. As for the 1st and 2nd piping 28 and 29, it is desirable that it is, the ingredient made from stainless steel, for example, the product, which has corrosion resistance, and it is desirable that the heater which can be heated at about 150 degrees C is formed in order to remove moisture. This is because the nitric acid NO3 which reacts with the nitrogen-monoxide gas NO or dinitrogen-oxide gas N2O used by diffusion process, and presents corrosive [ strong ] will arise if moisture remains.

[0022] The inert gas supply pipe 30 for passing and permuting inert gas, N2 [ for example, ], in the evacuation system 20 for dilution, such as moisture clearance and nitrogen-monoxide gas, is connected to the 1st piping 28, and the valve 31 of a pneumatic-control type is formed in this inert gas supply pipe 30. Moreover, pressure sensors 32 and 33 are formed, and a pressure sensor 32 is detectable in the range of 0 - 1000Torr, and a pressure sensor 33 can be detected for the 1st piping 28 in the range of 0 - 10Torr, and is formed in it through the valve 34 of a pneumatic-control type.

[0023] The pressure sensor 35 for detecting the pressure of the right above of a vacuum pump 27 is formed in the 2nd piping 29 through the hand valve 36. The change-over valves 38 and 39 which switch the trap 37 and exhaust air which remove drain water to the thing of acid systems, such as a

thing of diffusion-process systems, such as nitrogen-monoxide gas, moisture, and HCl, are formed in the lower stream of a river of said vacuum pump 27, and these exhaust air is processed with damage elimination equipment. in addition, the leak in which high evacuation, such as, as for the oxidation-treatment equipment which consists of the above configuration, preparing [ which is a seal means ] an O ring for each connection of the exhaust air system of the processing furnace 1, for example, is possible -- it considers as tight structure. Moreover, a burner 8, a heater 6, change-over valves 21 and 22, and combination bulb 26 grade are controlled by the control device 40 by which the program recipe of the desired oxidation-treatment approach was inputted beforehand, and oxidation-treatment equipment is constituted so that the desired oxidation-treatment approach may be enforced automatically.

[0024] Next, an operation of said oxidation-treatment equipment and the oxidation-treatment approach are described with reference to drawing 2 . first, the inside of the processing furnace 1 carries out heating control beforehand at a heater 6 at predetermined temperature, for example, 300 degrees C, while being opened by atmospheric air -- having -- **** -- this condition -- many -- the wafer boat 4 by which several semi-conductor wafers W were held is loaded in the processing furnace 1, the throat of the processing furnace 1 is sealed with a lid 3, and the inside of the processing furnace 1 is decompressed by the vacuum suction by the evacuation system 20. As for this reduced pressure thru/or vacuum suction, it is desirable to include a cycle purge. since the front face of the semi-conductor wafer W becomes inert gas, N2 [ for example, ], being supplied in the processing furnace so that the natural oxidation film may not be formed in the front face of the semi-conductor wafer W, and the front face of the semi-conductor wafer W nitriding that N2 is 100%, and being hard to oxidize at a next oxidation process in the case of said loading and a cycle purge -- this -- it should prevent -- O2 -- small quantity -- for example, it is supplied about 1%.

[0025] Said cycle purge is performed by repeating inert gas, for example, supply and a halt of N2, by turns, carrying out vacuum suction of the inside of the processing furnace 1. In this case, the inside of the processing furnace 1 is evacuated to a predetermined pressure, for example, 10-3Torr extent, by control of the combination bulb 26, detecting an exhaust air system by change-over valves 21 and 22, and detecting a pressure by the pressure sensors 32 and 33 by the operating state of a change and a vacuum pump 27 in the evacuation system 20. By supplying intermittently with the inert gas, for example, the repeat of closing motion of N2 of an inert gas supply valve, controlled by this evacuation condition by the predetermined flow rate, a cycle purge can be performed, the inside of the processing furnace 1 can be decompressed promptly, and inert gas can fully permute. That is, rapid reduced pressure (compaction of vacuum time of concentration) and a rapid permutation are attained by this cycle purge.

[0026] Next, temperature up of the inside of the processing furnace 1 is carried out to predetermined processing temperature, for example, 850 degrees C, by control of a heater 6 in the state of said evacuation. The inside of the processing furnace 1 is controlled to about -5mmH2O--10mmH2O to fine reduced pressure (760Torr), for example, atmospheric pressure, by switching an exhaust air system to the works exhaust air system 19 by change-over valves 21 and 22. After recovering in this condition (the temperature of a semi-conductor wafer is stabilized), it performs, desired oxidation treatment, for example, HCl oxidation. This oxidation treatment is performed in the state of fine reduced pressure by supplying and burning oxygen gas O2 and hydrogen gas H2 in a burner 8, and supplying the generated steam in the processing furnace 1 with hydrogen chloride gas HCl and inert gas, N2 [ for example, ].

[0027] If an oxidation-treatment process is ended, an exhaust air system will be switched to the evacuation system 20. After decompressing the inside of the processing furnace 1 by vacuum suction again, predetermined about temperature, for example, 300 degrees C, is made to lower the temperature in the processing furnace 1 by control of a heater 6. What is necessary is to return the inside of the processing furnace 1 to ordinary pressure in parallel to this, to carry out the unload of the wafer boat 4 from the inside of the processing furnace 1, and just to perform cooling (to cool to the temperature which can convey a semi-conductor wafer). Also as for the reduced pressure after said oxidation-treatment process termination thru/or vacuum suction, it is desirable to include a cycle purge.

[0028] Thus, it sets to the approach of holding the semi-conductor wafer W in the processing furnace

1 beforehand heated by predetermined temperature, carrying out temperature up of the inside of the processing furnace 1 to predetermined processing temperature, supplying the steam which is raw gas, and oxidizing the semi-conductor wafer W. Since it was made to perform the process of said temperature up under reduced pressure, where an oxidation kind is eliminated, temperature up of the semi-conductor wafer W can be carried out to predetermined processing temperature, formation of the natural oxidation film in a temperature-up process can be controlled, and the ultra-thin oxide film which was excellent in quality can be formed. Moreover, since the inside of the processing furnace 1 was decompressed by vacuum suction not only before the process of desired oxidation treatment but after the process, the excessive oxidation kind in parts other than a desired oxidation-treatment process can fully be eliminated, formation of the natural oxidation film can fully be controlled, and membraneous quality and thickness are uniform and can form the ultra-thin oxide film which was excellent in quality. It is possible to form SiO2 film whose thickness is about 2nm incidentally.

[0029] In said processing furnace 1, since the so-called cycle purge is included at reduced pressure thru/or the process which carries out vacuum suction, quick reduced pressure and a quick permutation are attained, and improvement in a throughput can be aimed at. Moreover, the burner 8 which is a steam supply means to supply a steam in the processing furnace 1 in said oxidation-treatment equipment, The works exhaust air system 19 which exhausts the inside of the processing furnace 1 with fine reduced pressure at the process of oxidation treatment, Since it has the change-over valves 21 and 22 which switch the evacuation system 20 which carries out vacuum suction of the inside of the processing furnace 1, and said works exhaust air system 19 and evacuation system 20 before and after an oxidation-treatment process, the oxidation-treatment approach mentioned above is enforced certainly and easily, and the thing of it can be carried out.

[0030] In this case, since said burner 8 consists of very small flow rates possible [ supply ] in the steam, it can form the ultra-thin oxide film which was further excellent in quality by fully taking film formation time amount. Moreover, the combination bulb 26 and the vacuum pump 27 are formed in said evacuation system 20, and since this combination bulb 26 is equipped with two functions, i.e., a closing motion function, and a pressure-modulating function by one, it can reduce the number of bulbs, can simplify the configuration of the evacuation system 20, and can aim at reduction of cost.

[0031] In addition, as shown, for example in drawing 3 , where reduced pressure control after a desired oxidation-treatment process and of the inside of the processing furnace 1 is carried out, predetermined pressure, for example, 100Torr extent, nitrogen-monoxide gas NO or dinitrogen-oxide gas N2O is supplied, and it may be made to perform diffusion process as the oxidation-treatment approach. Before and after this diffusion-process process, it is desirable to decompress the inside of the processing furnace 1 by vacuum suction, and it is desirable in it to be accompanied by cycle purge in that case. After wet oxidation, since nitrogen-monoxide gas NO or dinitrogen-oxide gas N2O is supplied after fully removing the moisture in a processing furnace by cycle purge, while fully being able to control generating of the strong corrosive nitric acid NH3, the high insulating SiON film can be formed and the improvement to reliable membraneous quality can be aimed at easily.

[0032] Drawing 4 shows the whole oxidation-treatment equipment configuration which is the gestalt of the 2nd operation of this invention. In the gestalt of this operation, the same reference mark is given to the same part as the gestalt of the 1st operation, explanation is omitted, and explanation is added about a different part. Neither the piping 14 for condensation nor the 2nd duct 15 is formed, but the combination bulb 26 made from Teflon is connected through the 1st piping 28 made from Teflon, a vacuum pump 27 is connected through the 2nd piping 29 same with this combination bulb 26 made from Teflon, and the evacuation system 20 is constituted by the 1st duct 11.

[0033] A pressure switch 25 and pressure sensors 32 and 33 are formed in the 1st piping 28. While the works exhaust air system 19 branches and is prepared, the change-over valves 21 and 22 which switch the works exhaust air system 19 and the evacuation system 20 are formed in the 2nd piping 29. The trap 41 is formed in the works exhaust air system. Moreover, the inert gas supply pipe 30 and the pressure sensor 35 are formed in the 2nd piping 29 through valves 31 and 36, respectively. The by-path pipe 42 which bypasses the combination bulb 26 is formed, to this by-path pipe 42, when making it the works exhaust air system 19, it opens, and when making it the evacuation system 20, the bypass valve 43 to close is formed in the 1st piping 28 and the 2nd piping 29. Also in the

oxidation-treatment equipment of the gestalt of this operation, the same operation effectiveness as the oxidation-treatment equipment of the gestalt of said operation is acquired.
[0034] Drawing 5 shows the whole oxidation-treatment equipment configuration which is the gestalt of operation of the 3rd of this invention. In the gestalt of this operation, the same reference mark is given to the same part as the gestalt of the 2nd operation, explanation is omitted, and explanation is added about a different part. A by-path pipe 42 is not formed in the 1st piping 28 and the 2nd piping 29, and it is not formed [ branch the works exhaust air system 19 and ] in the 2nd piping 29. It is desirable that the heater for removing moisture is formed in the 2nd piping 29. Pressure regulation is possible before vaccum pressure predetermined in the combination bulb 26 from closing motion and atmospheric pressure.
[0035] Namely, it sets to the oxidation-treatment equipment of the gestalt of this operation. The burner 8 which is a steam supply means to supply a steam in the processing furnace 1, With inert gas, having the vacuum pump 27 for evacuating the inside of the processing furnace 1, and carrying out vacuum suction of the inside of the processing furnace 1 before and after an oxidation-treatment process Replaceable and the desirable evacuation system 20 in which a cycle purge is possible, Since it was prepared in this evacuation system 20 and has the combination bulb 26 in which pressure regulation is possible before predetermined vaccum pressure from closing motion and an atmospheric pressure, the ultra-thin oxide film which was excellent in quality can be formed without requiring a works exhaust air system.
[0036] As mentioned above, although the gestalt of operation of this invention has been explained in full detail with the drawing, the various design changes in the range which is not limited to the gestalt of the above-mentioned implementation and does not deviate from the summary of this invention etc. are possible for this invention. For example, although it was made to perform oxidation treatment with the gestalt of said operation, exhausting the inside of a processing furnace to fine reduced pressure by the works exhaust air system, since it has the evacuation system, it is also possible [ evacuating the inside of a processing furnace by this evacuation system ] to perform oxidation treatment.
[0037] As a processing furnace, although the vertical mold furnace is illustrated, you may be a horizontal spindle furnace, and although the batch type is illustrated, you may be single wafer processing. As a processed object, you may be for example, a LCD substrate, a glass substrate, etc. in addition to a semi-conductor wafer. As a steamy supply means, it may not be limited to a combustion equation, for example, you may be a carburetor type, a catalyst type, an ebullition type, etc.
[0038]
[Effect of the Invention] According to this invention required above, the following effectiveness can be done so.
[0039] (1) Since the process of said temperature up is performed under reduced pressure in the approach of holding a processed object in the processing furnace beforehand heated by predetermined temperature, carrying out temperature up of the inside of a processing furnace to predetermined processing temperature, supplying raw gas, and oxidizing a processed object according to invention concerning claim 1, formation of the natural-oxidation film in a temperature-up process can control, and the ultra-thin oxide film which was excellent in quality can form.
[0040] (2) According to invention concerning claim 2, since the inside of a processing furnace is decompressed after the process of said oxidation treatment, formation of the natural oxidation film after an oxidation-treatment process can be controlled further, and the ultra-thin oxide film which was further excellent in quality can be formed.
[0041] (3) Since according to claim 3 the cycle purge which repeats supply and a halt of inert gas by turns is included while said reduced pressure carries out vacuum suction of the inside of a processing furnace, the inside of a processing furnace can be decompressed promptly and improvement in a throughput can be aimed at.
[0042] (4) Since vacuum suction of the inside of a processing furnace is carried out before and after the process of said oxidation treatment in the approach of holding a processed object in a processing furnace, supplying raw gas, and oxidizing at predetermined processing temperature according to claim 4, formation of the natural oxidation film in parts other than an oxidation-treatment process

can be controlled, and the ultra-thin oxide film which was excellent in quality can be formed.
[0043] (5) Since according to invention concerning claim 5 nitrogen-monoxide gas or dinitrogen-oxide gas is supplied after the process of said oxidation treatment, and in a processing furnace and diffusion process is performed, the improvement to reliable membraneous quality can be aimed at easily.
[0044] (6) Since the process of said vacuum suction includes the cycle purge which repeats supply and a halt of inert gas by turns according to invention concerning claim 6, carrying out vacuum suction of the inside of a processing furnace, vacuum suction achievement of the inside of a processing furnace can be carried out promptly, and improvement in a throughput can be aimed at.
[0045] (7) In the equipment which according to invention concerning claim 7 holds a processed object in a processing furnace, supplies raw gas, and is oxidized at predetermined processing temperature A raw gas supply means to supply raw gas in said processing furnace, and the works exhaust air system which exhausts the inside of said processing furnace by predetermined exhaust gas pressure, Since it has the means for switching which switches the evacuation system which carries out vacuum suction of the inside of said processing furnace by the pressure lower than the exhaust gas pressure of said works exhaust air system, and said works exhaust air system and evacuation system, Formation of the natural oxidation film in parts other than a desired oxidation-treatment process can fully be controlled, and the ultra-thin oxide film which was excellent in quality can be formed.
[0046] (8) According to invention concerning claim 8, since the possible combination bulb of closing motion and pressure accommodation and the vacuum pump are formed in said evacuation system, the configuration of an evacuation system can be simplified and reduction of cost can be aimed at.
[0047] (9) In the equipment which according to invention concerning claim 9 holds a processed object in a processing furnace, supplies raw gas, and is oxidized at predetermined processing temperature A raw gas supply means to supply raw gas in said processing furnace, and the evacuation system which has a vacuum pump for evacuating the inside of said processing furnace, Since it was prepared in this evacuation system and has the combination bulb in which pressure regulation is possible before predetermined vaccum pressure from closing motion and an atmospheric pressure, the ultra-thin oxide film which was excellent in quality can be formed without requiring a works exhaust air system.

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## DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing showing the whole oxidation-treatment equipment configuration which is the gestalt of the 1st operation of this invention.
[Drawing 2] It is drawing for explaining an example of the oxidation-treatment approach enforced by this oxidation-treatment equipment.
[Drawing 3] It is drawing for explaining other examples of the oxidation-treatment approach.
[Drawing 4] It is drawing showing the whole oxidation-treatment equipment configuration which is the gestalt of the 2nd operation of this invention.
[Drawing 5] It is drawing showing the whole oxidation-treatment equipment configuration which is the gestalt of operation of the 3rd of this invention.
[Description of Notations]
1 Processing Furnace
W Semi-conductor wafer (processed object)
8 Burner (Raw Gas Supply Means)
19 Works Exhaust Air System
20 Evacuation System
21 22 Change-over valve (means for switching)
26 Combination Bulb
27 Vacuum Pump

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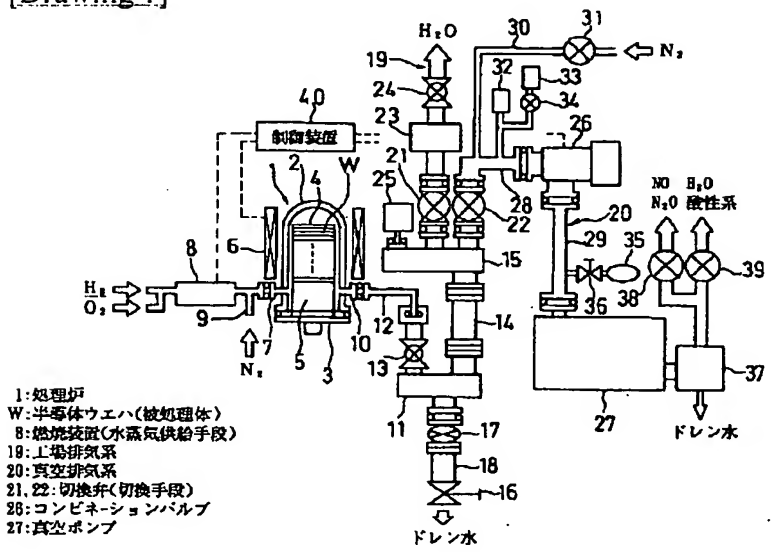
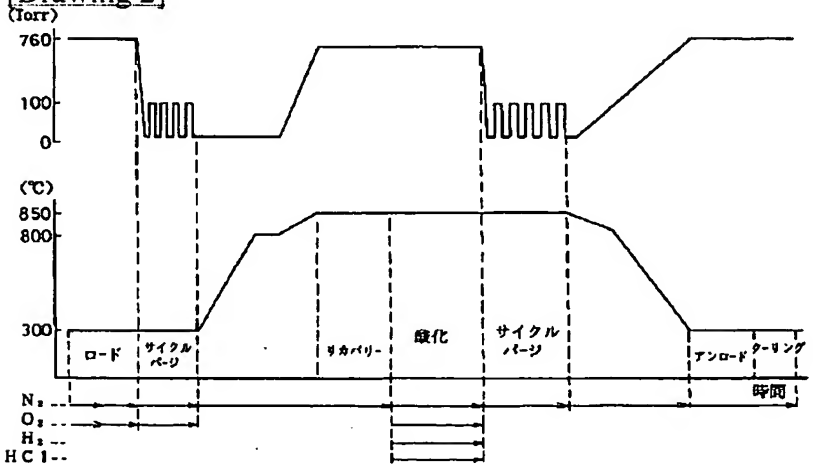
DRAWINGS

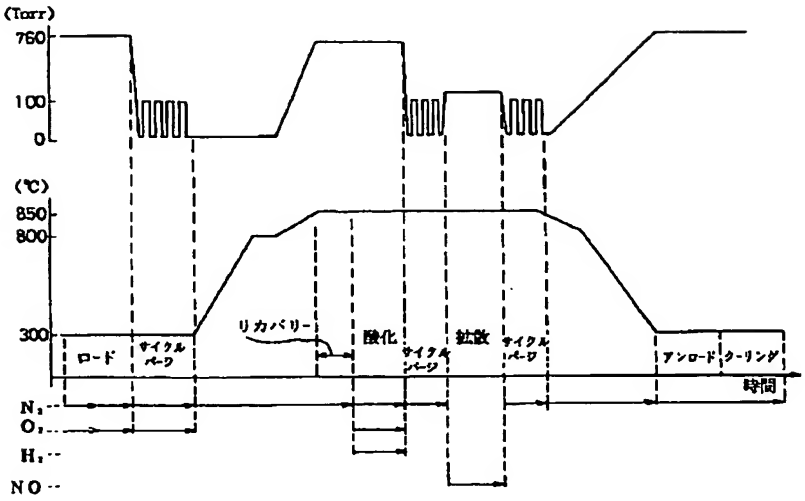
[Drawing 1]



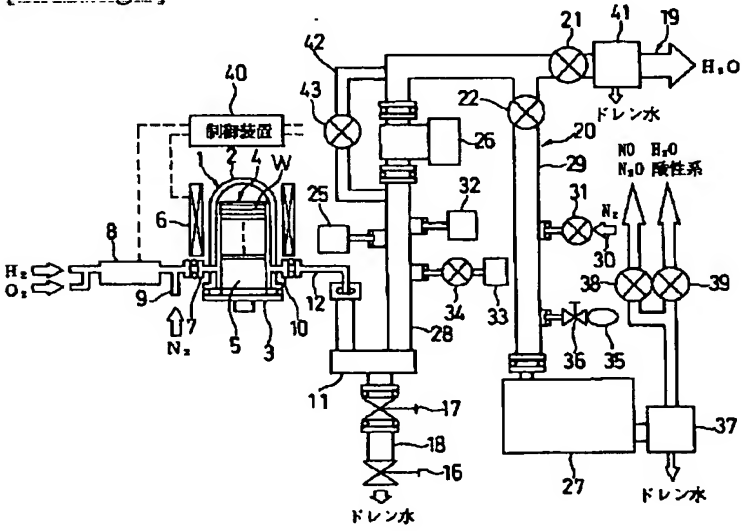

[Drawing 2]



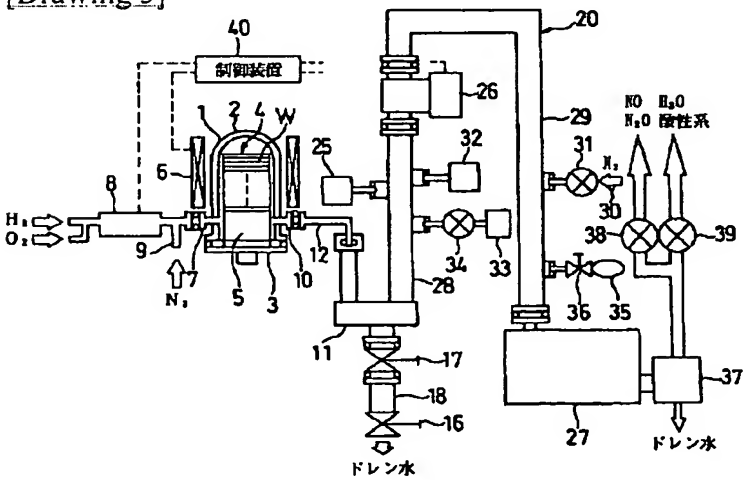

[Drawing 3]




[Drawing 4]




[Drawing 5]




[Translation done.]